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Anthropometric dimensions of hand and foot as predictors of stature: A study of two ethnic groups in Nigeria

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ABSTRACT

Background: Anthropometry as a science deals with the study of human measurements with a view towards the understanding of physical variations that exist in human population groups. Estimation of stature is very important in the investigation process of unknown and co-mingled human remains in mass casualties and natural disasters. Stature or height therefore is critically essential in human identification.

Aim: This study was aimed at determining stature using the anthropometric measurements of hand and foot dimensions in two ethnic Nigerian populations.

Methodology: A descriptive cross-sectional study involving 384 Nigerian students selected using random sampling technique was used. These subjects were male and female volunteers of two ethnic groups' aged between18 and 30 years. Cochran method for sample size determination was used. All measurements of hand and foot dimensions were recorded to the nearest centimetre using standardized anthropometric measuring equipment and the mean actual and estimated stature obtained.

Results: The study showed significant gender difference in mean right and left hand breadth but not the mean right and left hand length ($P < 0.05$). Similarly, there was a statistically significant gender difference between the mean right and left foot breadth ($P < 0.05$), but not between the mean right and left foot breadth and right foot lengths respectively ($P > 0.05$). The study further showed that in both gender, that breadth parameters showed stronger correlations in hand and foot dimensions. There was also a significant association between the mean left hand length and right and left hand breadth ($P < 0.05$) but not with the mean right hand length ($P = 0.853$). There was also significant association in the mean left foot length and the right and left foot breadths ($P < 0.05$) but not in the right foot lengths ($P = 0.294$). The mean estimated value of stature using linear and multiple regression equations for all parameters ranged from 164.53 cm to 165.57 cm while the mean actual stature from the study was 165.30 cm for all the subjects, specifically, 165.90 cm for the Igbos and 164.79 cm for the Isokos respectively.

Conclusion: Our study showed that stature can be accurately estimated using all hand and foot parameters and this is of medico-legal importance.

Contents

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1. Introduction

Anthropometry is the study of human measurements geared towards the understanding of the physical variations that exist in population groups. Identification of an individual is the mainstay of forensic investigation. Estimation of stature is important in the investigation process of unknown and co-mingled human remains in mass casualties and natural disasters. Stature, therefore is one of the criteria essential for human identification. It is also one of the most important and primary element in the formulation of biological profile in the process of personal identification of an individual.[1] Similarly it is the central dogma in anthropo-forensic examination.[1,2] Human stature is therefore an anatomical complex of linear dimensions.[3–5]

The investigation of footprints or dismembered foot dimension from the scene of a crime or disaster plays a crucial role in the effort to determine some characteristics of the subjects or victims.[6] The relationship between specific body dimensions or proportions can be used to solve crimes in the absence of complete evidence, hence the use of hand, foot or footprints at a scene of a crime to determine the stature of the supposed criminal.[7] Similarly the stature of a victim can be estimated when a part of the body, such as the hand, foot is all that remains.[7]

Age, gender, stature and race are often referred to as the four pillars of the identity of an individual with stature and gender being the two most important.[8] The human foot shows great variation in length, breadth and height in males and females due to genetic, natural and environmental factors and these have anthropological, clinical and forensic importance.[10] Similarly the human hand is the most multifaceted body structure, hence its usefulness in forensic identification in cases of mass disasters cannot be overemphasized. There is a strong correlation between hand and foot dimensions and stature, therefore, if either of the measurements is known the other can be calculated.[11] Towards this end, the present study was designed to correlate the hand and foot dimensions with stature in males and females of our studied population.

Several studies have demonstrated that anthropometric dimensions of hand and foot lengths, breadths and other parameters are important in stature determination.[7,10,11] Similarly, stature estimations have been reported in several studies especially on long bones.[12,13] However, only few exists as regards mutilated bodies and fragmented remains and certainly not in our studied population to the best of our knowledge. This is what this study intends to fill. Studies have also shown that anthropometric dimensions are population, racial, ethnic and gender specific.[10,11] In this regard scientists are mandated to use more recent formulae derived for a particular population as a result of secular trends in the populations.[1] This study will therefore provide basic anthropometric data for our studied population which will be useful in cases of natural calamities, terror strike, in crime scene and similarly be utilized in anthropometric studies for general growth and development of medical sciences. This will one way or the other affect the day to day life of the inhabitants and will also support the fact that variations exist not only between races but among ethnic groups. This study therefore provides anthropometric data and regression equations for two closely related ethnic groups in Nigeria.

2. Materials and methods

This was a descriptive cross-sectional study using 384 students volunteers, (164) males and (220) females of Delta State University, Abraka, Nigeria. They were of two ethnic groups, (192) Delta Igbos and (192) Isokos aged between 18 and 30 years. Simple random sampling technique was used to select the subjects for the study and the sample size was determined using Cochran method of 1997.[14]

All the participants for the study were apparently healthy, asymptomatic adult Nigerians to the second generation; that is parents and grandparents. Subjects with hands or feet deformities were excluded from the study. Prior to the study, ethical approval was sort from the Ethical Committee of the Faculty of Basic Medical Sciences, Delta State University, Abraka, with reference number DELSU/BMS/ANA/17/18/0004 dated 25th January 2018 giving approval for the study. Furthermore, the purpose of the study was explained to the participants and written informed consent was obtained before the commencement of the study.

A preliminary study on prediction of the existence of bilateral differences was carried out if there was a difference or not and this was tested with 40 subjects, 20 from each ethnic group and the results were not statistically significant using paired *t*-test ($p > 0.05$) in some parameters but significant in other parameters ($p < 0.05$). This has been documented by some previous workers.[15,16]

All the measurements were taken using standardized anthropometric measuring equipment; stadiometer, sliding calipers, anthropometer and recorded to the nearest centimetre. These measurements were carried out by only one of the authors at a fixed time daily from 7am to 11am to avoid any diurnal variation. The measurements were taken twice for each subject and the average was taken as the correct value provided the readings and measurements agreed within 0.04 ranges when this condition was not met, two further measurements were taken and the mean of the closest readings taken as the best estimate to prevent intra observer bias.[17] Extremity readings were taken from the left side of the individuals. Precision and reliability of these measurements were ensured, since only one of the authors was involved. This is necessary because precision and reliability are very important in

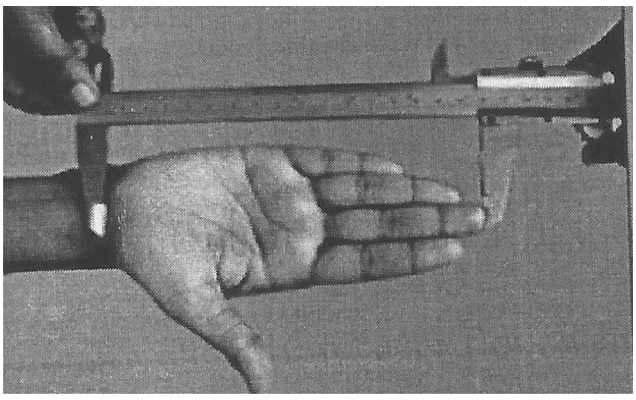

Fig. 1a. Landmarks for the measurements of hand length.

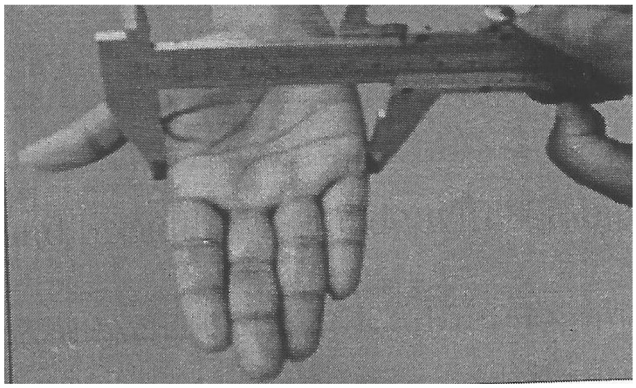

Fig. 1b. Landmarks for measurement of hand breadth.

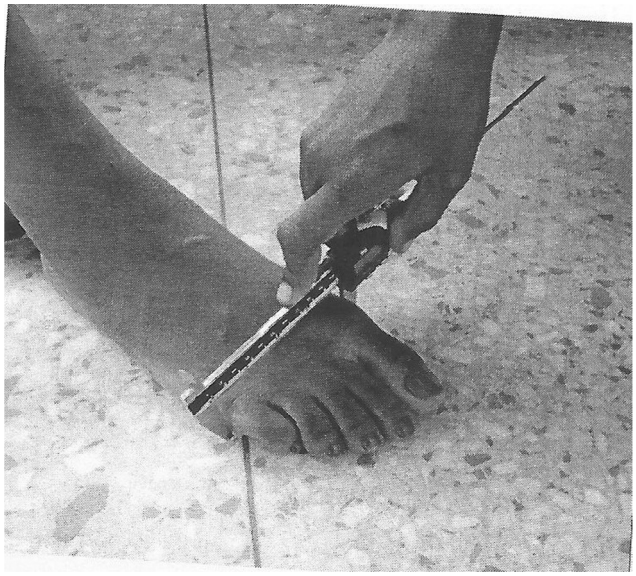

Fig. 2a. Landmarks for measurements of foot length.

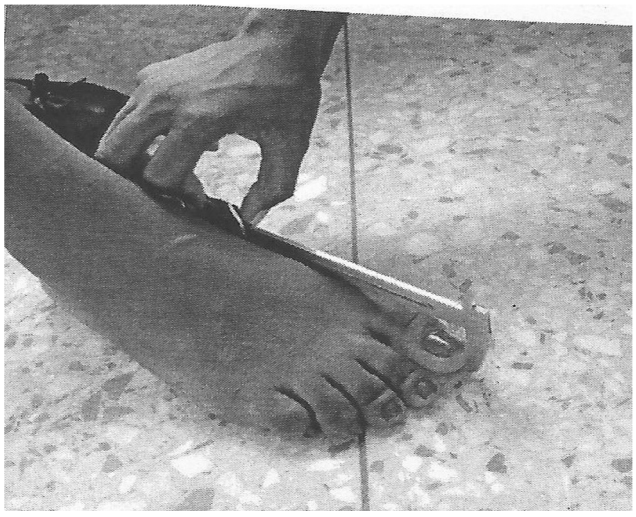

Fig. 2b. Landmarks for measurements of foot breadth.

forensic studies. The following measurements of hand lengths, hand breadths, foot lengths, foot breadths and heights were recorded on the data sheets provided.

The subjects removed their shoes and socks where applicable and were orientated in the standard anatomic position with the head on the Frankfort Horizontal plane. Height, two dimensions of hands and feet respectively were measured in line with the International Biological Programme Protocol.[9]

Height was taken from the vertex to the floor following the anatomic position and Frankfort plane using a stadiometer.

While collecting data, the anthrometer and calipers were regularly cleared after each use, since they can get dirty after measuring subjects with active perspiration.[1]

- Hand length (HL) was measured from the projected distance between the midpoint of a line joining the styloid process of radius and ulna bones of forearm to the tip of the middle finger using a sliding calliper (Fig. 1a).
- Hand breadth (HB) was measured from the base of the 5th to the 2nd metacarpal bones using a sliding caliper (Fig. 1b).

The measurements of the hand lengths and breadths were done with the subjects sitting with elbows flexed and drawn backwards, with forearm supinated and resting on the table with the wrist extended and hand stretched.

- Foot breadth (FB) was measured as the distance between the lateral and medial sides at the metatarsal region using a sliding caliper (Fig. 2a).
- Foot length (FL) was measured as the maximum distance between the most anterior and posterior projecting parts of the foot with an anthropometer (Fig. 2b).

The measurements of the foot lengths and breadths were made with the subjects in the standing position, with the right leg slightly bent and driven backward, allowing the body to rest on the right foot.

2.1. Statistical data analysis

The data obtained were descriptively analysed using the Statistical Package for Social Sciences (SPSS) version 22.0. Means, standard deviations (SD) and standard errors (SE) were calculated. Similarly linear and multiple regression equations and correlation coefficients between the mean height and the measured dimensions of hand lengths, breadths, foot lengths and breadths were determined. A previous study has shown that regression analysis presents smaller mean errors in estimation of stature than that of division factor method and gives better reliability of estimate than the latter.[17] We further check the accuracy of the regression equations by comparing the actual stature (Table 1) with the estimated stature (Table 8).

In the estimation of stature by regression analysis stature remained the dependent variable and the measured dimensions were the independent variables. The regression equation which was derive reflected the relationship between the measured dimensions and stature.[1] We used Pearson correlation coefficient because the original data were homogenous and the relationship between the variables were linear.

Table 1
Distribution of Stature (cm) among subjects.

Gender	Male	Female
Minimum	147	146
Maximum	192	189
Mean	166.0	164.6
Std	8.6	8.9
N	164	220

Evaluating the regression using models 1 and 2 showed that our data did not have large standardized residuals. Similarly there were no undue influential data in our sample. Furthermore, both our dependent and independent variables were quantitative in nature and appropriate sample size was utilized in the study. Our independent variables were not highly correlated making our correlation coefficients good and reliable an indication that these variables satisfied multicollinearity. Similarly our dependent variable exhibited the same amount of variance across the range of values for the independent variables, an indication of Homoscedasticity. Hence the results generated from this study can be generalized to the studied population. The comparison between ethnic groups was by means of one way analysis of variance (ANOVA). The significance of the results between the two ethnic groups was tested using student's *t*-test (independent). 'P' value of less than 0.05 was considered significant.

3. Results

All the participants were students of Delta State University, Abraka, aged between 18 and 30 years of which 57.30% (n = 220) were females and 42.70% (n = 164) were males with both ethnic groups constituting 50.00% (n = 192) each. This study was conducted between February to May 2018.

Table 1 shows the distribution of height in centimetre (cm) of the subjects in both genders. The height for males ranged from 147 to 192 cm while that of females ranged from 146 to 189 cm with the mean height being 166 ± 8.60 cm and 164.60 ± 8.90 cm in males and females respectively.

As shown in the table above, the height of males ranged from 147 to 192 cm and 146–189 cm in females. The mean stature in males was 166 ± 8.6 cm and 164.6 ± 8.9 cm in females.

Table 2 shows the descriptive statistics of hand parameters in both genders and on both sides of the body. The mean right hand length and breadth was longer in females than in males with the mean left hand length and breadth longer in males than females. There was statistically significant gender difference in the mean right and left hand breadth ($p < 0.05$). However there was no statistically significant gender difference in the mean right and left hand length ($p = 0.52$, and 0.528 respectively.

As observed in the table above, the mean right hand length and the right hand breadth was higher in females than in males while the left hand length and left hand breadth was higher in males than in females.

Table 3 illustrates the descriptive statistics of foot parameters in both genders and on both sides of the body. Both the mean right and left foot length and breadth were longer in males than females.

Tables 3 shows the gender differences in the foot parameters. There was statistically significant gender difference between the mean right and left foot breadth ($P < 0.05$). However, there was no statistically significant differences in the mean right and left foot breadth and right and left foot length ($P > 0.05$).

Table 4 shows the correlation between stature (height) and hand and foot parameters. The mean left and right hand lengths showed stronger correlation with stature than breadth parameters. However, there was no statistically significant variation between the right and left hand parameters ($p > 0.05$). Similarly, there was a stronger correlation between the mean right and left foot breadth than mean left and right foot length. However, there was statistical significant difference between the left and right mean foot breadth ($P < 0.05$).

Table 5 shows the comparison of hand and foot parameters between the two ethnic groups of Delta Igbos and Isokos. There was a statistical significant relationship between the mean left hand length, and mean right and left hand breadth ($p < 0.05$), however, there was no statistical significant relationship in the mean right hand length ($p = 0.853$). The mean right and left foot length, and right and left foot breadth were smaller among the Isoko ethnic group when compared to the Delta Igbos. There was also a statistically significant difference between the mean left foot length, and the mean right and left foot breadth ($p < 0.05$). However, there was no significant difference between the mean right foot length ($p = 0.294$).

Table 6 shows the Correlation Coefficient and Regression analysis between Height and Hand and Foot parameters with only left hand breadth of the combined population and Delta Igbos having significant correlation with respect to the height of the population studied ($p < 0.05$). However, multiple regression of the combined data revealed that all the hand and foot parameters contributed significantly to the height of the population studied.

Table 2
Descriptive statistics of hand parameters for both gender.

	Male				Female			
	Rt hand length	Lt hand length	Rt hand breadth	Lt hand breadth	Rt hand length	Lt hand length	Rt hand breadth	Lt hand breadth
Minimum	13.10	16.10	6.40	6.10	12.50	14.30	6.40	6.00
Maximum	23.00	23.00	10.50	9.50	23.7	24.30	12.10	11.40
Mean	18.33**	18.37*	8.33*	8.00	18.45**	18.27**	8.52	7.58*
Std	1.35	1.24	0.86	0.64	2.23	1.76	0.86	0.81

Rt = Right and Lt = Left.
** p = 0.52.
** p = 0.53.
* p < 0.05.

Table 3
Descriptive statistics of foot parameters for both gender.

	Male				Female			
	Rt foot length	Lt foot length	Rt foot breadth	Lt foot breadth	Rt foot length	Lt foot length	Rt foot breadth	Lt foot breadth
Minimum	19.00	18.00	6.50	6.54	19.10	18.00	5.00	5.01
Maximum	33.60	32.20	12.00	12.10	32.30	32.70	12.00	12.10
Mean	25.13	25.01	*8.83	8.82	25.04	24.29	*8.45	8.47
Std	3.61	2.71	1.15	1.17	2.71	3.70	1.12	1.15

Rt = Right and Lt = Left.
* p < 0.05.

Table 4
Correlation between stature (height) between hand and foot parameters in the studied population.

	Pearson's correlation	Significance (2-tailed)
Hand parameters		
Left hand Length	0.019	0.713
Right hand Length	0.028	0.590
Left hand breadth	−0.029	0.567
Right hand breadth	−0.053	0.302
Foot parameters		
Left foot Length	−0.059	0.249
Right foot Length	−0.078	0.126
Left foot breadth	0.111	0.029
Right foot breadth	0.101	0.048

Table 5
Comparison of Hand and Foot Parameters between the two ethnic groups of Delta Igbos and Isokos studied.

	Ethnic groups	Mean ± SD	P-value
Hand parameters			
Left hand Length	Delta Igbos	18.47 ± 1.50	0.046
	Isokos	18.15 ± 1.60	
Right hand Length	Delta Igbos	18.38 ± 2.00	0.853
	Isokos	18.41 ± 1.80	
Left hand breadth	Delta Igbos	8.00 ± 0.75	0.000
	Isokos	7.47 ± 0.68	
Right hand breadth	Delta Igbos	8.68 ± 0.89	0.000
	Isokos	8.19 ± 0.75	
Foot parameters			
Left foot Length	Delta Igbos	25.02 ± 2.96	0.013
	Isokos	24.18 ± 3.62	
Right foot Length	Delta Igbos	25.87 ± 2.80	0.294
	Isokos	24.92 ± 3.65	
Left foot breadth	Delta Igbos	9.00 ± 1.20	0.000
	Isokos	8.23 ± 1.00	
Right foot breadth	Delta Igbos	8.95 ± 1.19	0.000
	Isokos	8.27 ± 0.99	

Table 7 shows the linear Regression Model for Height estimation using Hand and Foot parameters. Using this model, the estimated height of studied population can be calculated and compared with the actual height of the subjects using the parameters studied. This will further show which of the parameters can best predict height or stature of the population studied.

Table 8 compares the mean actual stature and the mean estimated stature derived from hand and foot parameters. All the parameters of the hand and foot dimensions gave high predictive values for the estimation of stature. Ethnic differences were shown in all the parameters studied and were not as accurate predictively of stature estimation. However, multiple regression equation also gave a high predictive value for stature estimation.

4. Discussion

In this study, we took the adult sample age range of 18–30 years since the adult length of foot is attained by the age of 16 years in males and generally the stature at 18 years is accepted as adult as was indeed confirmed by another study. Similarly a decline in stature does not occur until the fifth decade of life.[16]

This study also showed the mean height for males to be 166 ± 8.60 cm while in females it was 164.60 ± 8.90 cm. This difference between males and females in height (stature) was not statistically significant as indeed other studies have shown that generally males have higher stature than females. Similarly Delta Igbos had a higher mean height than Isokos in our studied population.[18,19] Other authors have also documented this trend.[20,21]

4.1. Hand parameters in both genders

Our study showed statistically significant gender difference in mean right and left hand breadth ($p < 0.05$) but this was not the case with the mean right and left hand length. Previous studies of hand dimensions have demonstrated statistically significant

Table 6
Correlation coefficient and regression analysis between height and hand and foot parameters.

Variable	Group	R	R Square	Significance	SEE	Intercept	Slope
LT HAND LENGTH	Combined	0.091	0.008	0.289	8.78	155.917	0.513
	Igbos	0.132	0.017	0.069	8.39	153.888	0.742
	Isoko	0.009	0.00	0.096	8.62	162.258	0.046
RT HAND LENGTH	Combined	0.054	0.003	0.289	8.80	160.72	0.251
	Igbos	0.125	0.016	0.085	8.41	157.93	0.526
	Isokos	0.013	0.00	0.859	8.62	164.631	−0.062
LT HAND BREATH	Combined	0.196	0.039	0.000	8.64	147.83	2.263
	Igbos	0.190	0.036	0.008	8.45	150.475	2.14
	Isokos	0.041	0.002	0.576	8.61	159.27	0.511
RT HAND BREATH	Combined	0.063	0.004	0.218	8.79	159.10	0.644
	Igbos	0.044	0.022	0.549	8.46	171.170	−0.411
	Isokos	0.025	0.001	0.728	8.62	160.727	0.289
LT FOOT	Combined	0.058	0.003	0.260	8.80	161.59	0.153
LENGTH	Igbos	0.069	0.005	0342	8.45	172.528	−0.197
	Isokos	0.107	0.011	0.139	8.57	156.943	0.254
RT FOOT	Combined	0.046	0.002	0.372	8.08	162.24	0.124
LENGTH	Igbos	0.036	0.001	0.617	8.85	170.38	−0.11
	Isokos	0.089	0.008	0.218	8.58	157.858	0.210
LT FOOT	Combined	0.065	0.004	0.202	8.79	165.471	−0.010
BREATH	Igbos	0.126	0.016	0.81	8.401	167.822	−0.013
	Isokos	0.077	0.006	0.290	8.591	167.54	−0.547
RT FOOT BREATH	Combined	0.100	0.010	0.050	8.77	158.735	0.768
	Igbos	0.130	0.017	0.073	8.397	156.538	1.219
	Isokos	0.103	0.11	0.517	8.57	169.150	−0.743
Multiple regression of hand and Foot Parameters	Combined	0.242	0.059	0.004	8.63	148.713	0,153BLTHL − 0.050BRTHL3.351BLTHB − 1.639BRTHB. 0.145BLTFL−0.0 −135BRTFL 0.011BLTFB 0.303BRTFB

BLTHL = Combined Left hand Length, BRTHL = Combined Right hand Length, BLTHB = Combined Left Hand, Breadth, BRTHB = Combined Right Hand Breadth, BLTFL = Combined Left Hand Foot Length, BLTFB = Combined Right Foot Length, BRTFB = Combined Right Foot Breadth.

Table 7
Linear regression model for height estimation using hand and foot parameters.

Variable	Group	Equation
LT HAND LENGTH	Combined	H = 155.917 + 0.513LTHL
	Igbos	H = 153.88 + 0.742LTHL
	Isokos	H = 162.258 + 0.046LTHL
RT HAND LENGTH	Combined	H = 160.72 + 0.251RTHL
	Igbos	H = 157.93 + 0.526RTHL
	Isokos	H = 164.631–0.062RTHL
LT HAND BREATH Outline	Combined	H = 147.83 + 2.263LTHB
	Igbos	H = 150.475 + 2.14LTHB
	Isokos	H = 159.27 + 0.511LTHB
RT HAND BREATH	Combined	H = 159.10 + 0.644RTHB H = 171.170–0.411RTHB
	Igbos	
	Isokos	H = 160.727 + 0.289RTHB
LT FOOT LENGTH	Combined	H = 161.59 + 0.153LTFL H = 172.528–0.197LTFL
	Igbos	
	Isokos	H = 156.943 + 0.254LTFL
RT FOOT LENGTH	Combined	H = 162.24 + 0.124RTFL H = 170.38–0.11RTFL
	Igbos	
	Isokos	H = 157.858 + 0.210RTFL
LT FOOT BREATH	Combined	H = 165.471–0.010LTFB
	Igbos	H = 167.822–0.013LTFB
	Isokos	H = 167.54–0.547LTFB
RT FOOT BREATH	Combined	H = 158.735 + 0.768RTFB
	Igbos	H = 156.538 + 1.219RTFB
	Isokos	H = 169.150–0.743RTFB
Multiple regression of Hand and foot parameters	Combined	H = 148.713 + 0.153BLTHL0.050BRTHL + 3.351BLTHB − 1.639BRTHB + 0,145BLTFL − 0.135BRTFL0.011BLTFB + 0.303BRTFB

BLTHL = Combined Left hand Length, BRTHL = Combined Right hand Length, BLTHB = Combined Left Hand, Breadth, BRTHB = Combined Right Hand Breadth, BLTFL = Combined Left Hand Foot Length, BLTFB = Combined Right Foot Length, BRTFB = Combined Right Foot Breadth.

Table 8
Comparison of mean actual stature and mean estimated stature derived from hand and foot parameters.

Estimated stature Using regression equations	Combined subjects	Igbo subjects	Isoko subjects
LT Hand length	165.57 cm	167.58 cm	163.09 cm
RT Hand length	165.32 cm	167.59 cm	165.77 cm
LT Hand breadth	165.34 cm	167.59 cm	163.09 cm
RT Hand breadth	164.53 cm	167.60 cm	163.09 cm
LT Foot length	165.35 cm	167.35 cm	163.08 cm
RT Foot length	165.39 cm	167.53 cm	163.09 cm
LT Foot breadth	165.38 cm	167.70 cm	163.04 cm
RT Foot breadth	165.35 cm	167.45 cm	163.00 cm
Combined Hand and foot parameters (Using multiple regression equations)			165.43 cm
Actual stature	165.30 cm	165.90 cm	164.79 cm
LT = Left	RT = Right.		

difference between males and females in their studied population.[19,22] The possible explanation for the above findings may be due to hormonal, genetic and environmental factors which are very important in physical characteristics between gender.[23,24] Some studies have even related these gender changes to age of puberty which tends to occur 2 years later in males than females.[15,19]

4.2. Foot parameters in both genders

This study also showed that there was a statistically significant gender difference in the mean right and left foot breadth ($p < 0.05$) but not in the right foot length ($p > 0.05$). However, previous study by Ozaslan et al.,[20] demonstrated significant gender differences in all foot parameters. The differences in the findings could be explained by the geographical and racial differences between the populations studied. The lack of bilateral symmetry in all hand and foot parameters as demonstrated in our study, had been shown in some previous studies.[1,9,21–23]

4.3. Stature correlation between hand and foot parameters

This study has clearly demonstrated that the breadth parameters showed stronger correlation in hand and foot dimensions. This was different from the study by Mudasir et al.,[23] where in males the length parameters showed greater correlation than the breadth parameters. All the parameters in the study enumerated above showed statistically significant correlation with stature in both genders while in our study, it was only the mean left and right foot breadths that were statistically significant. Another study, showed that the highest correlation existed between stature and foot length.[21] This is an indication of variation in stature estimation in different population groups. Despite the foregoing, there was a strong correlation of all the parameters with stature in this study and hence any of these parameters can be used successfully for stature estimation. Furthermore, the correlation coefficient of the measured parameters suggest a linear and close relationship of stature with them as was also shown by Krishan.[16]

4.4. Hand and foot parameters among the two ethnic groups

This study has shown a statistically significant ethnic difference in the mean left hand length and the right and left hand breadths ($p < 0.05$), however, there was no statistical significant ethnic difference in the mean right hand length ($p = 0.853$). There was also statistical significant ethnic difference in the mean left foot length and right and left foot breadths ($p < 0.05$) with no statistical significant ethnic difference in the right foot lengths ($p = 0.294$). These findings were not supported by the works of Nirenbery et al; and Soo – Chan et al.;[23,24] that reported significant gender but not ethnic differences in foot parameters in South Koreans and Bengali adult female Muslims respectively. This is another evidence of ethnic and racial variability in hand and foot parameters.

Both linear and multiple regression equations were used to estimate the stature of the studied population. It was found that the mean estimated value of stature using all the parameters ranged

from 164.53 cm to 165.57 cm. The actual stature from the study was 165.30 cm for the combined subjects and 165.90 cm for Igbos and 164.79 cm for Isokos respectively. This is an indication that all hand and foot parameters can adequately predict stature in our studied population. These findings are in accordance with the study of Soo-Chan et al.[24] that showed that mean value estimates were close to each other. Our study has also shown that to assess the accuracy of our regression equations, the standard of estimate (SEE) is very valuable since it predicts the deviation of estimated stature from the actual stature. All the SEE in our study were closely related ranging from ±8.8 to ±8.80 (Table 6), thus confirming the accuracy of our equations.

5. Conclusion

This study has shown that stature estimation can be accurately derived using hand and foot parameters. However, it is possible to estimate stature using either hand or foot measurements since none of them was basically more reliable than the other. There was also ethnic variability in our studied sample. Equally important was that the formulae obtained from these estimations were population and ethnic specific. There is therefore the need for specific equations for ethnic and population groups. This study can be of importance in medico-legal cases where the initial priority is the establishment of the identity of the deceased person or persons most especially when the body parts have been mutilated and or only a part of the body is available. We therefore recommend this easy and cheap method of stature estimation in developing countries especially in disaster prone areas.

Author's contribution

All authors contributed significantly to the conceptualisation, data analysis and the write up of the manuscript with data analysis and the write up of the manuscript with no conflict of interest.

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Conflict of interest

The authors declared that there is no conflict of interest.

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